Probing the Interface Morphology and Microstructures in Layer Materials Using Angular Dependence of X-ray Fluorescence (ADXRF) and Grazing Incidence X-ray Scattering (GIXS) Techniques

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X-ray measurements using a combination of ADXRF and GIXS techniques allow a nondestructive and element-specific method for characterizing the morphology of buried interfaces and microstructures in layer materials. In the present work, these techniques are applied to a study of two prototype systems: $Si_{1-x}Ge_x$ epilayers grown on Si by molecular beam epitaxy (MBE) and CdS/CdTe heterostructures grown on glass by rf sputtering followed by thermal annealing at various temperatures. By a comparison of the experimental data with model calculations, the layer thickness, interfacial roughness, correlations between interface height fluctuations, as well as the depth profile of a selected atomic species can be determined. Our results show that the $Si_{1-x}Ge_x$ alloys can form very smooth interfaces with practically no intermixing of atoms with the Si substrate. On the other hand, strong intermixing of constituent atoms across the interface between CdS and CdTe layers has been found as a result of thermal annealing at sufficiently high temperatures.

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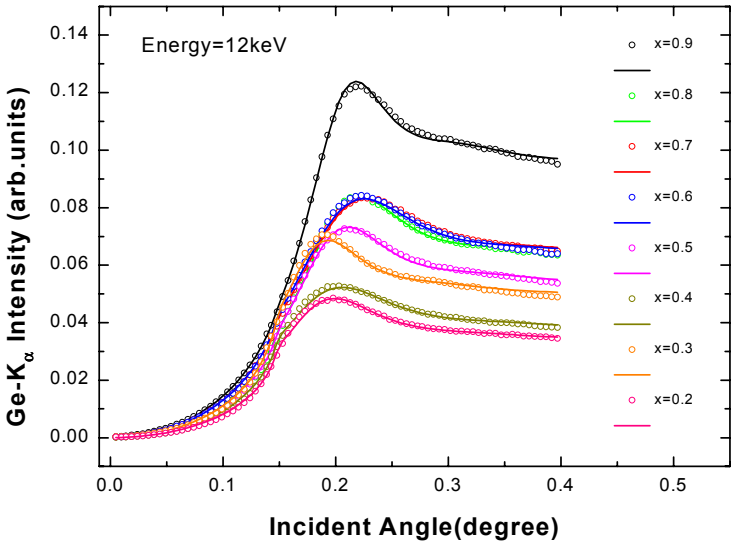

Figure1. ADXRF data for $Si_{1-x}Ge_x$ films